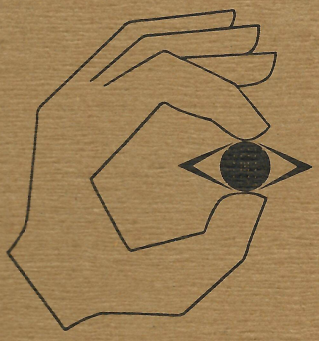
C215



TELEQUIPMENT

PLUG-IN AMPLIFIER

TYPE A

MANUAL

TELEQUIPMENT

PLUG-IN AMPLIFIER

TYPE A

All TelequipmenT instruments are subject to continuous development and improvement, consequently this instrument may incorporate minor changes in detail from the information contained herein.

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TYPE A VERTICAL AMPLIFIER - GENERAL PURPOSE

GENERAL

The Type A plug-in is a four-stage dual-range direct-coupled amplifier providing a low impedance output to drive the CRT Y plates directly. A nine-position frequency-compensated input attenuator, in conjunction with the x10 gain facility or a x10 probe, ensures the acceptance of a wide range of input levels.

TECHNICAL DATA

	x1 GAIN	x10
3dB bandwidth - d.c. coupled	d.c.-15MHz	d.c.-800kHz
a.c. coupled	2Hz-15MHz	2Hz-800kHz
10-90% risetime	23ns	440ns
Deflection sensitivity ± 5%	0.1-50V/cm	0.01-5V/cm
Maximum input (via 400V capacitor on AC)	400Vp	
Input impedance approx.	1megohm & 40pF	
Calibrator output	1Vp-p ± 2%	
Overall dimensions approx.		
Height	$2\frac{1}{2}$ in	6 cm
Width	$7\frac{3}{4}$	20
Depth	$13\frac{1}{2}$	34
Net weight approx.	3 lb	1.4 kg

OPERATION

Input

The outer of the UHF socket and the LOW terminal are not connected directly to chassis but through a 100 ohm resistor. In most applications this resistor may be shorted-out by the plated earthing link, but where multiple-earth

paths introduce problems, reference should be made to the General Description section of the main part of the manual.

DC-AC switch

The AC setting will usually be found more convenient, to avoid frequent resetting of the shift controls due to changes in d.c. level of input signals. However the DC position should be used for d.c. voltage measurement and for displaying low-frequency signals when the input time-constant on AC is inadequate to prevent waveform distortion. If d.c. blocking at very low frequencies is desired, the signal should be fed through an external capacitor, greater than 0.1μF, with the switch at DC.

Volts/cm

A setting should be chosen to produce a convenient amplitude of display. The calibrations refer to the x1 Y gain condition.

Y shift & Vernier

These act as coarse and fine controls for positioning the display in the vertical axis. Their effect is magnified in the x10 gain condition. Clockwise rotation causes downwards deflection of the trace.

Y gain

The x1 or x10 buttons should be selected as appropriate for the amplitude of the signal to be observed. The volts/cm indications should be divided by 10 in the x10 gain condition.

Gain may be readily checked as follows:-

Check gain x1: With x1 button depressed and input switch at DC, set VOLTS/CM to 0.2, link CAL 1Vp-p and INPUT and adjust SET x1 for 5cm of display.

Check gain x10: With x10 button depressed set VOLTS/CM to 2 and adjust SET x10 for a 5cm display.

CIRCUIT DESCRIPTION

Input attenuator - Figure A1

C1 is by-passed by S1 in the DC position of the input switch. Four frequency-compensated resistive dividers, singly or in tandem, provide nine division ratios selected by S2. The first section gives ratios of 1, 10 or 100:1 and the second section 1, 2 or 5:1. C4, 5, 8, 9, 12 & 13 provide equalisation of input time-constant for all settings of S2, while C2 & 3 affect compensation only when a high-impedance probe is used.

Amplifier - Figure A2

The single-sided output from the attenuator is applied to the grid of V1. V2 grid is returned to input low. V1 & 2 form a cathode-coupled paraphase amplifier, providing a push-pull output at the anodes. Shunt-peaking inductors L21 & 22 are adjusted for optimum pulse response. To provide constant-current operation and stability of gain, the cathodes are long-tailed to a negative bias source obtained by rectification of the 12.6V heater supply. RV40 determines the gain of the stage by variation of cathode coupling.

In the x10 position of S3, the anode loads of V1 & 2 are increased in value thus increasing gain by a factor of 10. RV41 enables this increase to be accurately set. Astigmatism correction preset RV50, introduced in the anode supply in the x10 position, enables the overall d.c. level of the amplifier and hence Y plate potential to be maintained constant in both settings of the Y gain switch.

The signal at the anodes of V1 & 2 is mixed with the d.c. shift potential provided by RV29 & 34 and fed to the grids of cathode-followers V5a & b.

The output at the cathodes of V5a & b is applied directly to the grids of the second amplifying stage V3a & 4a, where a second phase-inversion occurs. Shunt-peaking is provided by L23 & 24.

From the anodes of V3a & 4a the signal passes to the grids of output cathode-followers V3b & 4b. Neons N1 & 2 protect V3b & 4b against excessive grid to cathode potentials, by striking and conducting after switching on, until cathode bias voltage is developed by the valves conducting.

The CRT Y plates are driven from the cathodes of V3b & 4b via damped series-peaking inductors L25 & 26, these consist of 16 turns of wire around 4.7kilohm resistors. The output at the cathode of V3b is also taken to the trigger selector switch, S101 in the timebase trigger circuit, for internal triggering of the sweep.

RECALIBRATION

The following procedure should be adopted if a more thorough recalibration is required than the gain checks outlined in the operation section.

A squarewave amplitude calibrator is required with an output in the region of 1kHz, variable between 50mV and 100Vp-p. For step 7 a squarewave generator of 5ns or better risetime is necessary with a termination to match its impedance. The generator should have an output of up to approximately 500mV at a frequency from 100kHz to 1MHz.

1 Preliminary

Plug the amplifier into an oscilloscope, switch on and leave for at least 15 minutes to enable thermal conditions to become stable.

2 Gain x1

Select DC, 0.1V/cm, x1 gain and apply a 500mVp-p 1kHz squarewave. Adjust SET x1 for 5cm deflection.

3 Astigmatism balance

With SET x10 fully anti-clockwise, remove signal, short INPUT to chassis, switch off timebase, centralise spot and adjust oscilloscope FOCUS and ASTIG controls for minimum spot size. Switch to x10 gain and recentre spot. Adjust RV50, located towards rear on right-hand side of amplifier, for minimum spot size.

4 Gain x10

With x10 gain still selected, remove short from INPUT, apply 50mVp-p 1kHz squarewave and switch on timebase. Adjust SET x10 for 5cm deflection.

5 Attenuator compensation

Switch to x1 gain and set VOLTS/CM and 1kHz calibrator output as follows. Adjust appropriate trimmer for best squarewave with no under or over-shoot at the corners.

Volts/cm	Calibrator Vp-p	Adjust
0.2	1	C12
0.5	2.5	C13
1	5	C 4
2	10	C 8
5	25	C 9
10	50	C 5

6 Probe adjustment and attenuator compensation for probe

Remove squarewave input and connect probe between INPUT and calibrator. Set VOLTS/CM and 1kHz calibrator output as below and adjust appropriate trimmer for best squarewave. The calibrator output is stated for a x10 probe.

Volts/cm	Calibrator Vp-p	Adjust
0.1	5	Probe
1	50	C 2
10	100	C 3

7 High-frequency compensation

Remove probe and connect the fast-rise squarewave generator via appropriate termination. With x1 gain and VOLTS/CM at 0.1, feed in between 300 & 500mV p-p at a frequency from 100kHz to 1MHz. Adjust cores of L21, 22, 23 & 24, with a low-capacitance trimming tool, for best transient response, square corners and flat tops. L21 & 22 mainly affect the corners, while L23 & 24 have more influence on the d.c. level immediately following the corners.

INPUT ATTENUATOR

Cct. ref.	Part number	Value	Description	Tol. %	Rating
R1	319-0005-01	900k	HS	1	¼
R2	319-0119-00	990k	HS	1	¼
R3	319-0096-00	111k	HS	1	¼
R4	319-0120-00	10.1k	HS	1	¼
R5	319-0112-00	500k	HS	1	¼
R6	319-0118-00	800k	HS	1	¼
R7	319-0031-01	1M	HS	1	¼
R8	319-0103-00	250k	HS	1	¼
R9	319-0031-01	1M	HS	1	¼
R10	316-0104-01	100k	C		
R11	316-0101-01	100	C		
R12	316-0180-01	18	C		
R13	316-0101-01	100	C		
R14	316-0180-01	18	C		
C1	285-0772-00	0.1	PE	10	400
C2	281-0137-00	6-30p	CT		350
C3	281-0137-00	6-30p	CT		350
C4	281-0137-00	6-30p	CT		350
C5	281-0137-00	6-30p	CT		350
C6	285-0854-00	100p	PS	2p	350
C7	285-0850-00	1,000p	PS	5	125
C8	281-0137-00	6-30p	CT		350
C9	281-0137-00	6-30p	CT		350
C10	285-0842-00	15p	PS	1p	500
C11	285-0867-00	20p	PS	1p	500
C12	281-0137-00	6-30p	CT		350
C13	281-0137-00	6-30p	CT		350
C14	285-0843-00	30p	PS	2p	500
C15	285-0842-00	15p	PS	1p	500
C16	285-0769-00	0.01	PE	20	400
S1	260-0926-00		Slide		
S2	260-0953-00		Rotary		

Carbon resistors are 10% ¼W unless otherwise shown.

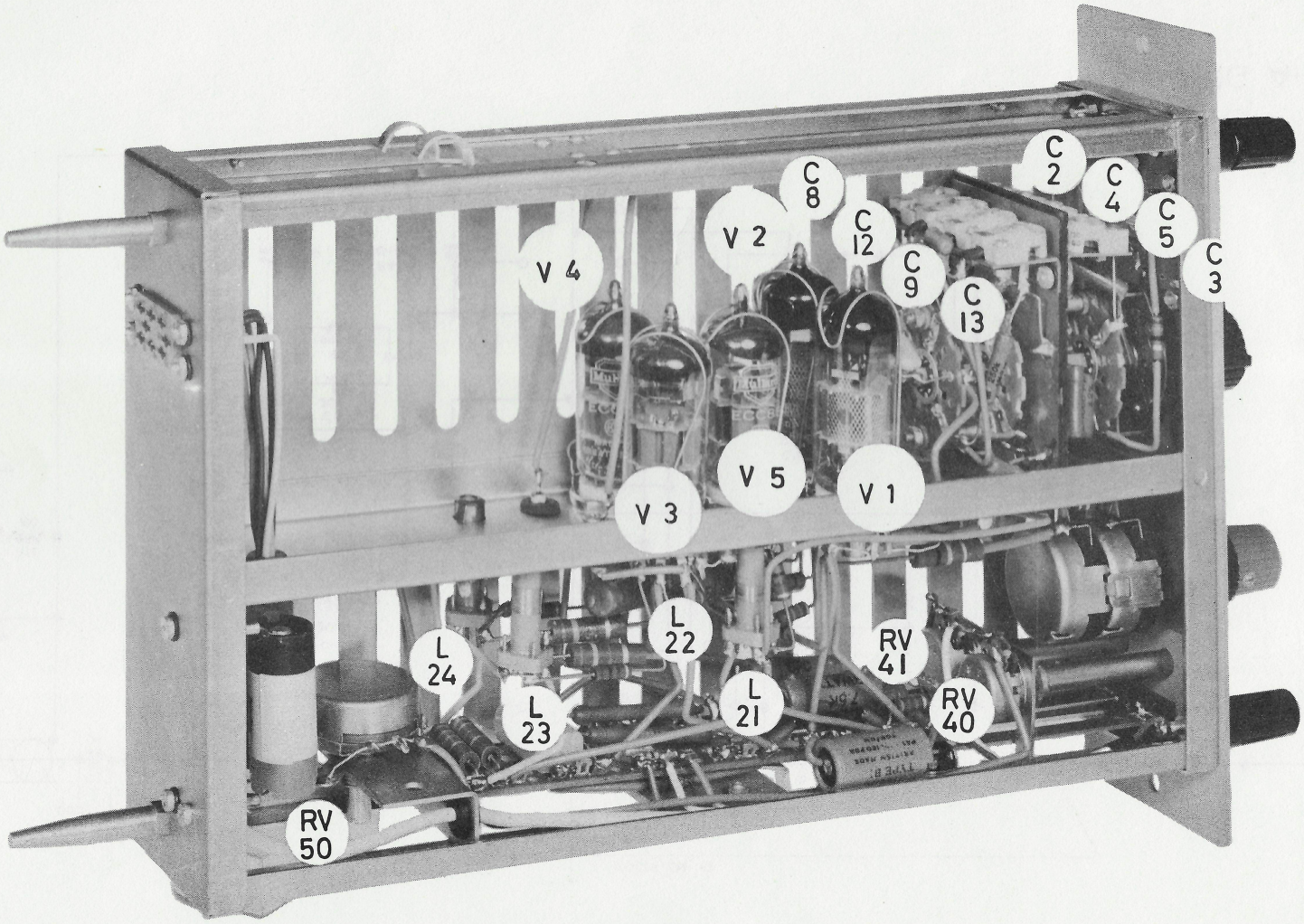
AMPLIFIER

Cct. ref.	Part number	Value	Description	Tol. %	Rating
R21	316-0223-01	22k	C		
R22	316-0102-01	1k	C		
R23	316-0152-01	1.5k	C		
R24	316-0101-01	100	C		
R25	316-0102-01	1k	C		
R27	316-0101-01	100	C		
R28	307-0184-00	15k	MO	5	1½
RV29)	311-0753-00	(25k	CV	20	2
RV34)		(100k	CV	20	2
R30	307-0184-00	15k	MO	5	1½
R31	316-0101-01	100	C		
R32	308-0485-00	7.5k	WW	5	2
R33	316-0563-01	56k	C		
R35	316-0563-01	56k	C		
R36	316-0101-01	100	C		
R37	316-0101-01	100	C		
R39	308-0485-00	7.5k	WW	5	2
RV40	311-0730-00	1k	CP	20	¼
RV41	311-0747-01	25k	CP	20	¼
R42	307-0141-00	2.7k	MO	5	1½
R44	316-0100-01	10	C		
R45	308-0476-00	10k	WW	5	3½
R46	308-0476-00	10k	WW	5	3½
R47	307-0141-00	2.7k	MO	5	1½
R48	316-0101-01	100	C		
R49	316-0101-01	100	C		
RV50	311-0751-00	25k	CP	20	2
R51	316-0101-01	100	C		
R52	308-0485-00	7.5k	WW	5	2
R53	308-0489-00	3.3k	WW	5	3½
R54	316-0101-01	100	C		
R55	308-0485-00	7.5k	WW	5	2
R56	316-0222-01	2.2k	C		
R57	316-0102-01	1k	C		

Carbon resistors are 10% ¼W unless otherwise shown.

Cct. ref.	Part number	Value	Description	Tol. %	Rating
R58	316-0152-01	1.5k	C		
R59	316-0103-01	10k	C		
R60	316-0103-01	10k	C		
C20	290-0399-00	8	RE		25
C21	285-0772-00	0.1	PE	10	400
C22	290-0113-01	8	E		150
C23	290-0386-00	250	E		18
C24	290-0386-00	250	E		18
C25	285-0792-00	4,700p	PE	20	125
L21	114-0251-00	3.9-7.5µH	Variable inductor		
L22	114-0251-00	3.9-7.5µH	" "		
L23	114-0252-00	9.1-20µH	" "		
L24	114-0252-00	9.1-20µH	" "		
L25	108-0484-00	1.15µH	Inductor (on 4.7k resistor)		
L26	108-0484-00	1.15µH	" " "		
MR1	152-0339-00	50V	Si rectifier		0.5A
N1	150-0069-00		Neon 3L		
N2	150-0069-00		Neon 3L		
S3	260-0997-00		Push		
V1	154-0535-00		EF184/6EJ7		
V2	154-0535-00		EF184/6EJ7		
V3	154-0187-01		ECC88/6DJ8		
V4	154-0187-01		ECC88/6DJ8		
V5	154-0187-01		ECC88/6DJ8		

Carbon resistors are 10% $\frac{1}{4}$W unless otherwise shown.



TYPE A COMPONENT LOCATIONS

PLATE A1

INPUT ATTENUATOR TYPE. A

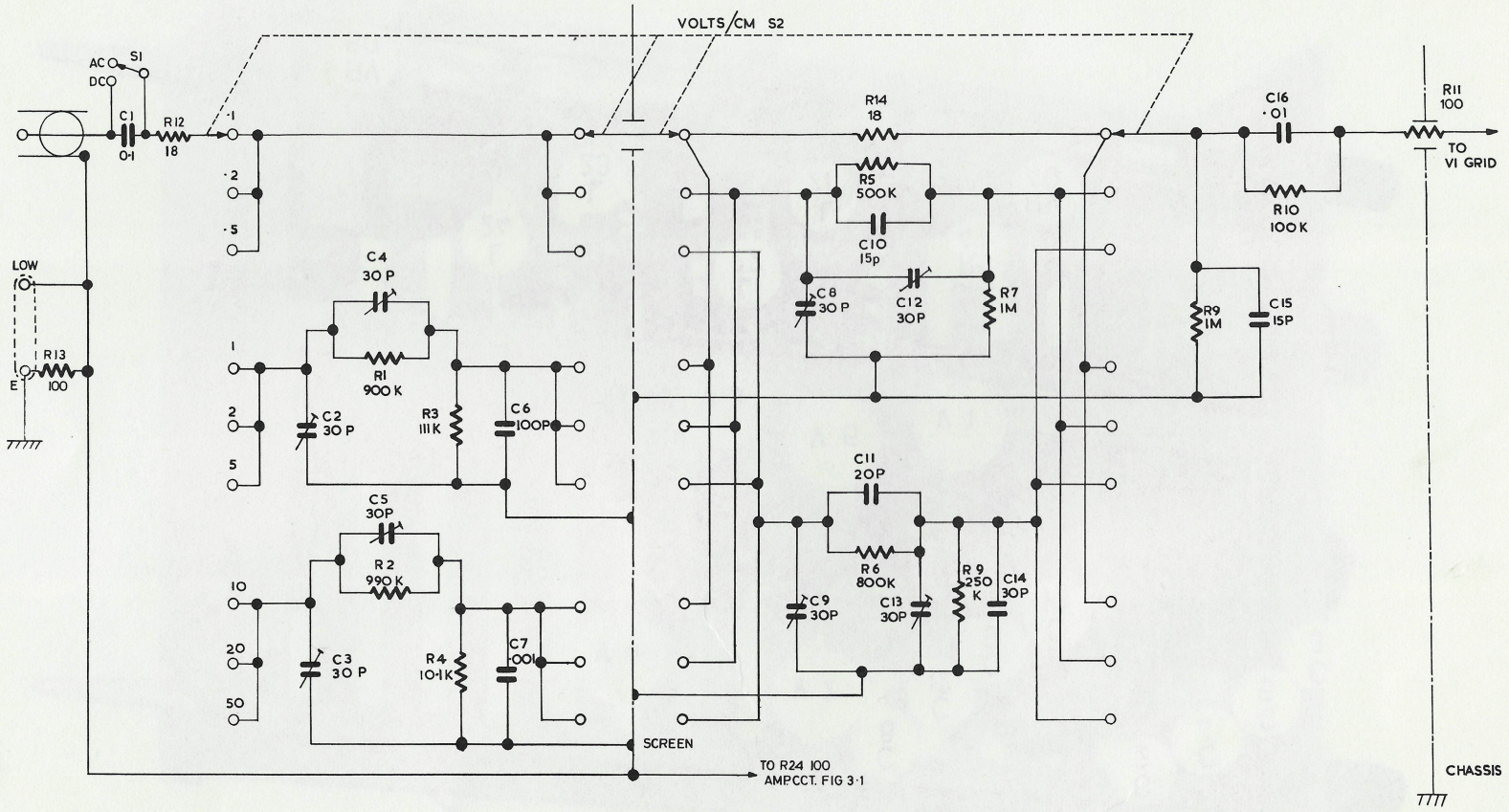
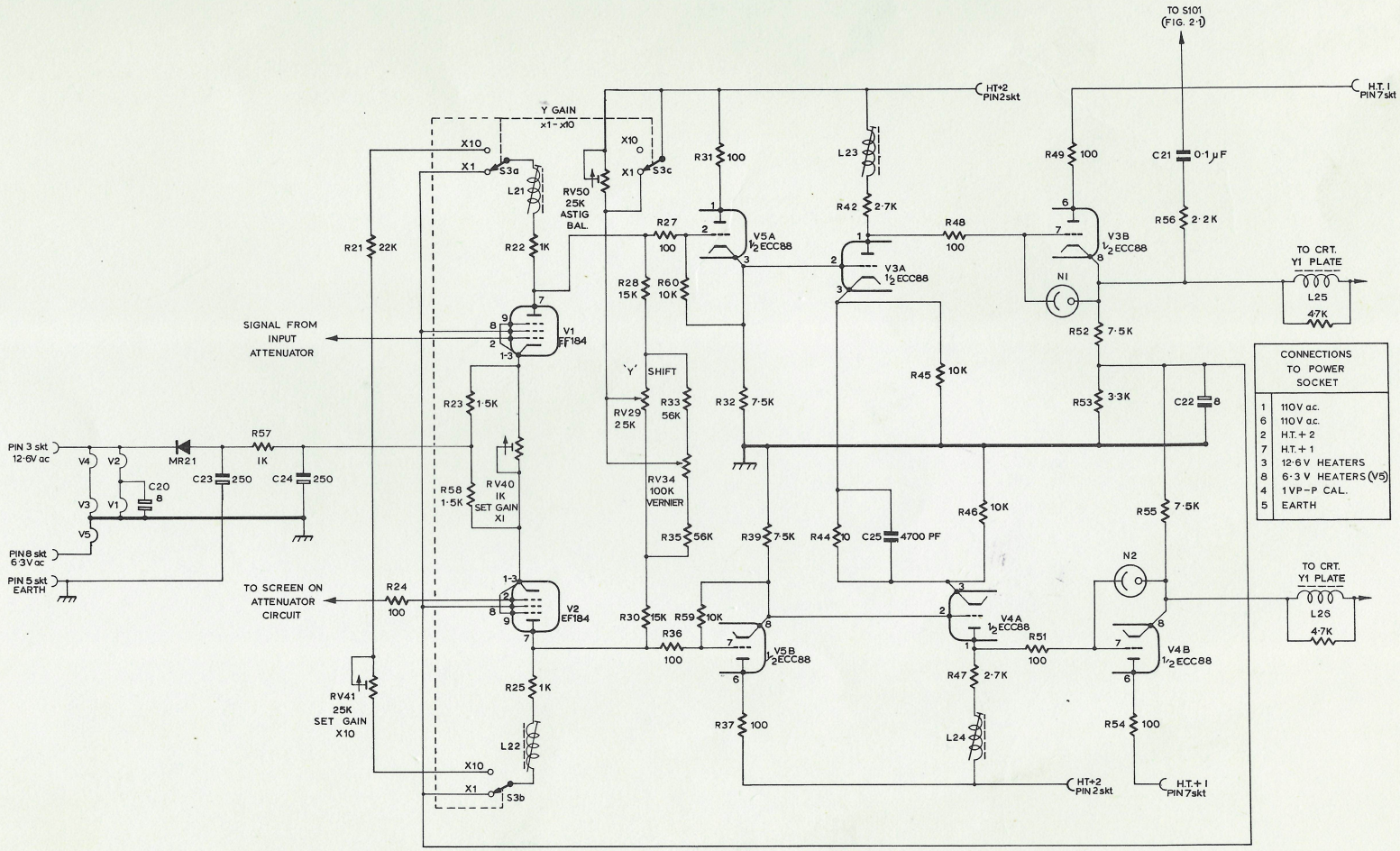


FIG A·1



VERTICAL AMPLIFIER TYPE A

FIG A·2

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